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REVIEW

Is any surgical procedure ideal for chronic pancreatitis?

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Abstract Chronic pancreatitis continues to be a major therapeutic challenge for all pancreatic surgeons. This article is written with a purpose to review various surgical procedures developed from time to time for the relief of pain in these patients. Since no single procedure can be labeled as “ideal” because of the problems of the inability to address the whole pathology at the initial procedure, failure or recurrence of the pain; most of the pancreatic and practicing surgeons may benefit from knowledge of the various procedures being performed, even though the personal experience of the surgeon most of the time ultimately dictates the final choice of the procedure for the patient.

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Introduction

It was Rufus of Ephesus (c. 100AD) who named the organ “Pancreas” (in Greek Pan: all, Kreas: Flesh or meat). Then it was Homer who used the word “sweetbread” broadly to describe animal flesh.¹ This organ with the name sweetbread, however, turns quite bitter as soon it develops the pathological condition called Chronic pancreatitis.

Chronic pancreatitis has been defined as a continuing inflammatory disease of the pancreas

characterized by irreversible morphologic changes that typically cause pain and or permanent loss of function.^{2–4} An ideal classification system for chronic pancreatitis would be simple, objective, accurate, incorporating etiology, pathogenesis, structure, function and clinical status into one overall scheme. Although these criteria have never been met, several systems have been advocated. The most widely used classification systems includes Marseille classification of 1963^{3–5} with revisions in 1984⁶ and 1988⁷ and the Cambridge classification of 1984.^{8,9} The Cambridge system proves more useful as a staging system once the diagnosis has been established. The most recent Marseille-Rome classification 1988⁷ includes more causal factors but proves to be more useful in defining rather than

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classifying chronic pancreatitis. The reported incidence and prevalence of chronic pancreatitis have increased markedly probably due to the changes in alcohol consumption and improved sensitivity of diagnostic tests. Early series from Copenhagen,¹⁰ the U.S.¹¹ and Mexico City¹² reported a similar incidence of about 4 per 100,000 inhabitants per year and prevalence rate of 45.5 per 100,000 in males and 12.4 per 100,000 in females.¹³ Recent advances in techniques and genetics provide possibilities for early and accurate identification of risk factors leading to chronic pancreatitis. Chronic pancreatitis has been categorized into toxic, idiopathic, genetic, autoimmune, recurrent attacks of acute pancreatitis and obstructive (TIGAR-O risk factor classification system version 1). The classification is based on prevalence of each etiological factor and has implications for potential treatment.¹⁴

The inflammatory component of chronic pancreatitis is incurable and conventional treatment strategies are directed towards palliation and management of complications. Medical management which consists of enzyme replacement, control of diabetes with insulin and oral analgesics is generally effective, although eventually one third of the patients will need surgery during the course of their disease.

The surgical management of pancreatitis has seen its ups and downs over the past few decades. The risks of pancreatic surgery were initially high but a few surgeons were bold enough to approach the chronically inflamed and enlarged pancreas. A number of surgical procedures have been developed during the 20th century to deal with the condition. Review of literature indicates the maximum efficacy of any procedure to be 85–90%. There is no procedure evolved to provide a 100% cure for the condition.¹⁵ Therefore surgery is aimed at controlling pain and managing complications rather than halting the progression of the disease. An appropriate and effective procedure has been difficult to devise and at the moment there is no clear “market leader” operation and the choice depends up on a grey zone where in pathological picture, patient’s condition and available expertise dictate the final procedure the patient undergoes.

The ideal procedure for treating pain in chronic pancreatitis should be the one which is simple, easy to perform, associated with low morbidity and mortality, and at the same time should provide adequate drainage and not augment endocrine and exocrine insufficiency.

Indications for surgical intervention

Currently the following are considered the acceptable indications for surgery.¹⁶

1. Intractable pain.
2. Suspicion of malignant neoplasm.
3. Non-resolving ductal stenosis.
4. Non-resolving common bile duct stenosis.
5. Pseudo-aneurysms or vascular erosions not controlled by radiological intervention.
6. Endoscopically not controlled large pseudo-pancreatic cyst.
7. Intractable internal pancreatic fistula.

Preoperative evaluation and patient selection

Once a patient has been selected to undergo surgery for pain relief, a thorough preoperative evaluation must be performed. Two important questions must be answered.

1. Will this patient benefit most from a decompression of the pancreatic ductal system or from resection of pancreas?
2. Is this patient harboring a pancreatic malignancy?

The various biochemical and radiological tests for preoperative assessment and diagnosis are as follows.

Blood tests

Elevations of serum amylase and lipase are found helpful during acute attacks of pain. In the later stages chronic pancreatitis atrophy of the pancreatic parenchyma can result in serum enzyme levels within the reference range, even during acute exacerbations.

While low levels of serum trypsin are specific for advanced chronic pancreatitis, they are not sensitive enough to be helpful in most patients with mild to moderate disease.¹⁷

Laboratory studies to identify causative factors include serum calcium and triglyceride levels.

Fecal tests

Steatorrhoea may be present in advanced chronic pancreatitis but neither qualitative nor quantitative fecal fat analysis can detect early disease.

Direct tests

Tests to detect chronic pancreatitis early are invasive and expensive.

Determination of duodenal aspirates

Pancreatic secretions are stimulated by exogenous secretion to achieve maximal output. The bicarbonate, protease, amylase and lipase output is then measured in the duodenal aspirates. This test is, however, only available in specialized centers.

Determination in pancreatic juice

This test is performed at the time of endoscopic retrograde pancreatography (ERCP). The pancreatic duct is freely cannulated, an external secretagogue is administered and the pancreatic juice is then aspirated out of the duct as it is produced. The bicarbonate, protease, amylase and lipase output is then measured. This test is gaining popularity because most patients undergo ERCP during the evaluation of chronic pancreatitis.

Indirect test

Non-invasive tests in principle work via oral administration of a complex substance that is hydrolyzed by a specific pancreatic enzyme to release a marker substance. The marker is then absorbed by the intestine and in turn measured in the serum or urine. These tests are capable of detecting moderate to severe degrees of chronic pancreatitis. Liver, renal and intestinal disease may interfere with the interpretation of these tests. They are not freely available in the United States.^{17–19}

Imaging studies

Structural changes in the pancreas and its ductal system are only seen during the moderate and severe stages of the disease, so most imaging procedures cannot depict early chronic pancreatitis.

Abdominal radiograph

Pancreatic calcification is observed in 30% of cases. They first form in the head and then in body and tail. Paired anteroposterior and oblique views are preferred because the vertebral column may otherwise obscure small specks of calcification.

Computerized tomography

Although CT excels at depicting the morphological changes of advanced chronic pancreatitis, the early changes are beyond its resolution and a normal finding on this study does not rule out chronic pancreatitis. CT is most useful to identify complications and in planning surgical or endoscopic intervention.¹⁷

Endoscopic retrograde pancreatography (ERCP)

ERCP provides the most accurate visualization of the pancreatic ductal system and has been regarded as the criterion standard for diagnosing chronic pancreatitis. Conversely one limitation of ERCP is that it cannot be used to evaluate the pancreatic parenchyma, and histologically proven chronic pancreatitis has been documented in the setting of normal pancreatogram. The pancreatogram can be classified according to several schemes such as Cambridge criteria.

A comparison of pancreatogram scoring with direct pancreatic function tests demonstrates good correlation. However, pancreatography tended to show more significant severe changes. ERCP is invasive, expensive, requires complete opacification of the pancreatic duct to visualize side branches and carries a risk of pancreatitis.^{17,20,21}

Magnetic resonance cholangiopancreatography (MRCP)

MRCP imaging provides information on the pancreatic parenchyma and adjacent abdominal viscera and uses heavily T₂ weighted images to visualize the biliary and pancreatic ductal system. The use of secretin during the procedure enhances the quality to enable the diagnosis of early chronic pancreatitis; however, it is relatively safe, reasonably accurate, non-invasive, fast and very useful in planning surgical and endoscopic intervention.^{17,22,23}

Endoscopic ultrasound (EUS)

EUS may be the best test for imaging the pancreas as per the recent studies. By placing the transducer immediately adjacent to the pancreas, the endoscopic approach eliminates the interference by bowel gas and enables the use of high frequency probes to enable acquisition of detailed imaging. Eleven sonographic criteria have been developed that identify characteristic findings of chronic pancreatitis. Using these criteria EUS correlates well with endoscopic pancreatic ductography and intra-ductal secretin tests in moderate and severe disease. EUS may be useful in diagnosing chronic pancreatitis in a subset of patient with non-ulcer dyspepsia. More experience is required to determine its utility in detecting the early stages of chronic pancreatitis.^{17,20}

Other tests

A secretin stimulated ultrasound study is one way of looking for the resistance to pancreatic juice

outflow at the level of the duodenum. The diameter of the pancreatic duct is measured at baseline and then 15 and 30 min after injection of secretin. Dilatation to a diameter greater than normal or for a longer period implies the presence of peripapillary stricture or papillary stenosis.^{17,20}

What is the most appropriate procedure?

The choice of surgical procedure depends upon the indication for surgery and the characteristics of disease in the individual patient. In general it is most appropriate to select a procedure which is likely to achieve the maximum symptomatic pain relief and also maximally preserve the functional pancreatic tissue.

Drainage procedures were developed on the basis that the pain in chronic pancreatitis is due to ductal hypertension²⁴ and proper drainage could decompress it. On the other hand the theories of perineural inflammation as the cause of pain lead to the development of resectional procedures.²⁵

A. Drainage procedure,

1. Partial: draining the duct partially,
 - a. Sphincterotomy and sphincteroplasty,
 - b. Duval procedure,
 - c. Puestow Gillesby procedure,
 - d. Leger's procedure,
 - e. Marcadier procedure,
2. Complete: draining the main duct completely,
 - I. Pancreaticojejunostomy,
 - a. Partington–Rochelle procedure,
 - b. Bapat's modification of Partington's procedure,
 - II. Pancreaticogastrostomy,
 - a. Moreno Gonzales procedure.

B. Resectional procedures,

- a. Whipple's operation,
- b. Traverso–Longmire procedure,
- c. Begar's procedure,
- d. Denervated pancreatic flap,
 - Warrens denervated pancreatic flap,
 - Shires denervated splenopancreatic flap,
- e. Subtotal pancreatic resection,
- f. Childs procedure,
- g. Total pancreatectomy,
 - With duodenal preservation,
 - Without duodenal preservation.

C. Extended drainage procedure,

- a. Rumpf's extended drainage.

D. Resection with extended drainage,

- a. Extended Begar's procedure,

- b. Frey's procedure,
- c. Izbicki V shaped ventral pancreatic excision.

E. Pancreatic denervation alone,

- a. Left splanchnicectomy with celiac ganglionectomy,
- b. Left splanchnicectomy, celiac ganglionectomy with bilateral vagotomy,
- c. Complete pancreatic denervation,
- d. Transthoracic/videothoroscopic pancreatic denervation,

F. Pancreatic auto-transplantation,

- a. Islet cell transplantation,
- b. Segmental pancreatic transplantation.

Drainage procedures

These drainage procedures proved pain relief in up to 60–80% cases.¹⁵

Partial drainage procedures

Sphincterotomy and sphincteroplasty

Transduodenal sphincterotomy was originally proposed by Doubilet and Mulholland for the treatment of chronic pancreatitis with the mistaken belief that the disease was caused by bile reflux.²⁶ The operation did not prove effective and subsequent attempts to improve pancreatic drainage by dividing the septum between the bile duct and the pancreatic duct have not proved popular.²⁷ In chronic pancreatitis it is unusual to find a uniformly dilated duct obstructed at the termination only therefore it follows that these procedures are unlikely to prove successful; however, early success rates of 50%^{26,27} when pain relief was assessed at 5 years have not been sustained.²⁸ Although surgical sphincterotomy has largely been given up; similar procedures have been recently performed endoscopically with enthusiasm.²⁹

Duval procedure

Decompression of the main pancreatic duct is achieved by resection of the pancreatic tail and retrograde drainage of the pancreatic duct via a termino-lateral pancreaticojejunostomy (Fig. 1). However, this procedure will only be effective if there is a single stricture between pancreatic tail and the ampulla of Vater which in most of the cases is unlikely.^{30,31}

Puestow Gillesby procedure

They recommend a longitudinal opening of the pancreatic duct from the site of the transaction of the duct after resection of the pancreatic tail and spleen to a point to the right of the mesenteric vessels and invagination of the open duct with pancreas into a Roux-en-Y loop of jejunum, thus

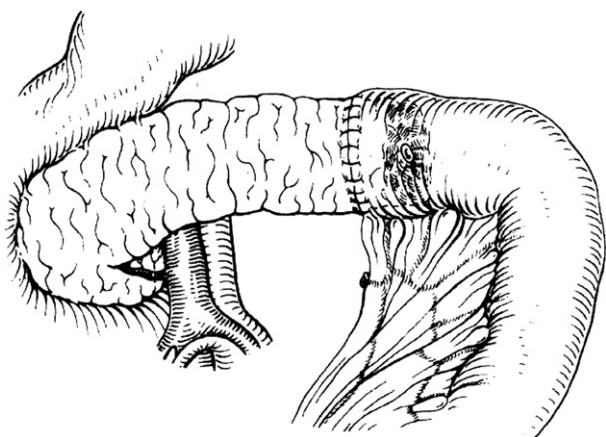


Figure 1 The Duval procedure.

ensuring a wider drainage of the ductal system (Fig. 2). This procedure takes care of multiple strictures seen in chronic pancreatitis.^{31,32}

Leger's procedure

This procedure developed for distal strictures involves a 40% distal pancreatectomy with splenectomy followed by opening of the pancreatic duct into a loop of jejunum by a retrograde lateral pancreaticojejunostomy.³³

Mercadier procedure

Here only the body of the pancreas is drained into a Roux-en-Y loop of jejunum by a side to side anastomosis.¹⁵

Partial drainage procedures have been abandoned because of the small anastomosis which tends to occlude. Also the concept of preservation of the spleen with pancreatic tail is important as it

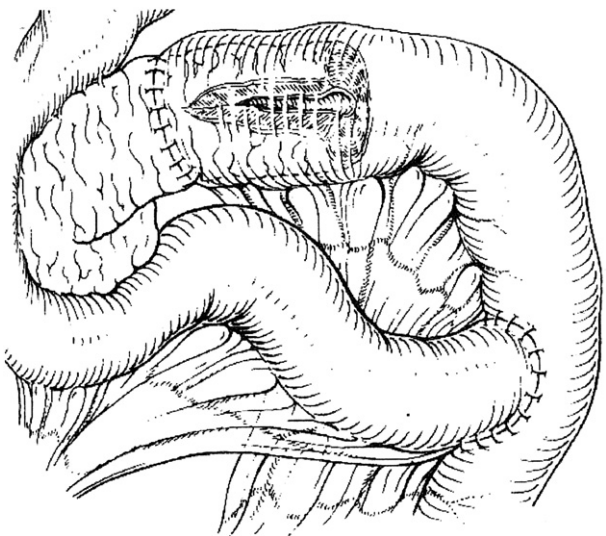


Figure 2 The Puestow Gillesby procedure.

prevents post-splenectomy sepsis³⁴ and delays the onset of diabetes mellitus.³⁵

Complete drainage procedures

Pancreaticojejunostomy

Partington–Rochelle procedure. This procedure is a refined Puestow procedure. It consists of a side to side long pancreaticojejunostomy, at least 10 cm without, resection of the pancreatic tail or the pancreas. However, a dilated main pancreatic duct (minimum 8 mm) is a prerequisite for a good duct to mucosa anastomosis.³⁶ In one of the largest series Greenlee³⁷ reported significant improvement in 82% of these patients with lateral pancreaticojejunostomy with an extended follow up of up to 25 years. Similar results have been reported by others.^{33,38} In our experience, this procedure has been performed on more than 90 patients of chronic pancreatitis with a duct size of more than 7 mm since 1985 till date. We strongly are in favour of this procedure in any patient with a duct size of more than 7 mm because of the technical ease, low morbidity, and excellent long-term results. We observed significant long-term improvement in more than 80% of our patients operated at SKIMS.

Bapat's procedure. It is modification of Partington's procedure. Here the pancreatic duct is opened from head to tail with wide drainage by a side to end pancreaticojejunostomy after fish mouthing the jejunal end to a required length. A duct to mucosa anastomosis is performed. Again the prerequisite is a dilated duct of at least 7 mm. This procedure is more physiological and ensures a straight conical dependent anastomosis with effective and complete drainage.³⁹

Pancreaticogastrostomy

Pancreaticogastrostomy has been advocated by some to be a better form of drainage procedure than pancreaticojejunostomy.⁴⁰ The procedure is performed as a mucosa to mucosa anastomosis over a T tube. A pain relief of up to 79% has been reported⁴¹; however, more patients developed steatorrhea because of the inactivation of the pancreatic enzymes by gastric acid. However, most surgeons still regard pancreaticojejunostomy as the drainage operation of choice.

Moreno Gonzales procedure. Pancreatic and bile duct drainage is established into an isolated vascularised loop of jejunum which is then anastomosed to the duodenum. The procedure has potential advantages, it allows the return of bile and pancreatic secretions into the duodenum and there is no pancreaticocibal asynchrony.³⁸

In conclusion the patients with ductal dilatation of more than 7–8 mm, no inflammatory mass or

ductal abnormality in the head and uncinate process are the most suitable candidates for lateral pancreaticojejunostomy. The results of pancreaticojejunostomy are difficult to interpret. Many reports have differing indications, different forms of surgery and inadequate follow up. In general however, all forms of drainage procedures tend to worsen over time especially if patients do not abstain from alcohol.⁴²

Resectional procedures

The head is considered to be pacemaker of the disease and its complications. A mass in the pancreatic head is found in 30–60% of the patients with chronic pancreatitis.^{43,44} No study has yet conclusively shown pain being only attributable to main duct obstruction and it is difficult to think of a good reason to believe so. The pathogenesis of pain is most likely not only related to ductal and parenchymal hypertension but also to the theory of perineural inflammation.²⁵ In addition lateral pancreaticojejunostomy never drains the second and third order pancreatic ducts, hence the concept led to the development of resectional procedures.

Whipple's operation (1935)

The procedure although first described by Allen O Whipple in 1912, but published much later for malignant lesions of the head of the pancreas is now also used for benign inflammatory mass in the head with a non-dilated pancreatic duct. The procedure consists of a pancreaticoduodenectomy with reconstruction by a pancreaticojejunostomy/gastrostomy, gastrojejunostomy and choledochojejunostomy. This is a complex and technically challenging procedure with higher mortality rates as compared to drainage procedure, however, with good results. This procedure involves excising normal organs much against the principles of surgery for a benign disorder and has given way to more conservative approaches.⁴⁵ However, it is the preferred surgical option if there is any suspicion of malignancy, as in such a situation there should be no compromise on the radicality of the procedure.

Traverso–Longmire procedure

Originally used in 1994 for a peri-ampullary tumor by Watson,⁴⁶ it was subsequently used by Traverso–Longmire for chronic pancreatitis in 1978.⁴⁷ As a gastrectomy is avoided and the pylorus and the proximal duodenum are preserved it achieves a better postoperative nutritional status, minimizes postgastrectomy syndromes as well as the incidence of marginal ulceration. For these

reasons it has almost become the form of resection for patients requiring pancreaticoduodenectomy in chronic pancreatitis.

Recent reports on pancreaticoduodenectomy for chronic pancreatitis have recorded a low mortality rate of 0–1%, significant pain relief of 80–100%.^{48–50} The incidence of diabetes increased from 17 to 44% in the preoperative period to 26–64% in the postoperative period.^{48,51,52} However, the onset of diabetes on follow up rather than immediately after the surgery suggests progression of the disease rather than the effect of surgery.

Hans Begar's procedure

This procedure is indicated in chronic pancreatitis with inflammatory mass in the head with medically intractable pain, obstruction of the common bile duct, duodenal stenosis or portal hypertension due to compression of portal vein by inflammatory mass. It is a duodenum sparing resection of the head of the pancreas thus preserving duodenal physiology and normal intestinal continuity which has significance in terms of postoperative nutritional status, blood sugar control and marginal ulceration. Two major steps are involved:

Resection: The pancreas is transected at the border between the head and the body above the superior mesenteric vein leaving a small disk of the head between the common bile duct and the duodenal wall.

Drainage: The body of the pancreas is drained by an end to end pancreaticojejunostomy and the pancreatic head by a side to side anastomosis to the rim of the resection cavity.^{53–55}

The procedure seems to be safe with perioperative mortality of 0–0.8%. Significant relief of pain has been reported in 86–92% of patients.^{56–59} It is not associated with fresh development of diabetes in the early postoperative period. However, existing diabetes may worsen in 10–13% of the patients.^{56,58} However, late diabetes develops in 21% of the patients due to progression of the disease. DPPHR when compared to PPPD has a superior outcome because of better pain control, weight gain, better glucose tolerance and higher insulin secretion capacity.⁴³

Denervated pancreatic flaps

In Warrens procedure the pancreas is divided over the portal superior mesenteric vein after ligation of the splenic artery and vein. The pancreatic head is excised leaving a thin rim. The remaining pancreas is not drained. Ligation of splenic vein and artery is presumed to denervate the gland.⁶⁰

Shires et al. described a more elaborate procedure called a denervated splenopancreatic flap

for patients with small duct pancreatitis.⁶¹ The procedure includes complete mobilization of the pancreas from the retroperitoneum, resection of the head and the uncinate process leaving a small rim near the duodenum, division of the splenic vein near its junction with the superior mesenteric vein and drainage of the distal pancreatic remnant into a Roux-en-Y limb of jejunum. The complexity of the procedure and its unproven efficacy may limit its usefulness.

Subtotal pancreatic resection

Excision of the body and distal pancreas used to be a commonly performed procedure during 1960–1970 but with the development of better imaging facilities it was noted that disease in the body and the tail is often secondary to disease in the head of the pancreas, thereby limiting its role. This procedure is still indicated when the disease is confined to the body and tail e.g., pseudocyst, failed pancreaticojejunostomy, non-dilated duct, pseudo-aneurysm and when there is suspicion of a malignant lesion in the body and tail. Here up to 80% of the distal pancreas is resected beyond the neck of pancreas, and the pancreatic duct is closed. A concomitant splenectomy is unavoidable in the majority of patients because of dense fibrosis precluding the isolation of the splenic vessels. However, splenic preservation may be possible in 20–34% of patients.^{62–64} Another procedure described by Warsaw in which splenic salvage is achieved by preservation of the short gastric vessels early mortality is 0–4%^{63–64} and pain relief is 70–88%.^{65,66} About 20% develop diabetes in the early postoperative period. Severe hypoglycemic coma and brain damage occur in 2–4% of all such patients.⁶⁴ Further an increased incidence of steatorrhoea is seen in 15%.⁶⁶

Childs resection

This procedure first described by Barret and Bowers in 1957⁶⁷ was popularized by Child. It is a 95% distal pancreatectomy. The spleen, the tail, body and uncinate processes are completely removed. The small cuff of the head that is preserved protects the vascularity and common bile duct during surgery. This procedure is performed when lesser procedures have failed or when the entire pancreas is severely diseased.⁶⁸ Pain relief is about 90% with a mortality of up to 4%^{64,65} while diabetes develops in 50% of patients⁶⁴ and the incidence of early steatorrhoea increases by 30%.⁶⁶

Total pancreatectomy

Total pancreatectomy bringing in its wake permanent endocrine and exocrine deficiency is usually

offered as a last resort to patients with chronic pancreatitis who have diffuse involvement of the pancreas with non-dilated ducts, suspicion of malignancy or failed previous procedure. The operative mortality ranges from 0 to 10%^{48,63,66–72} and pain relief is achieved in 80%.⁶⁶

In the absence of counter regulatory hormones control of sugar is very difficult (brittle diabetes). Hypoglycemic attacks after total pancreatectomy can lead to death or irreversible brain damage. Patients who are already insulin dependent and need pancreatic supplementation for steatorrhoea are ideally suited for this procedure.

Duodenum preserving total pancreatectomy

Russel in 1987 reported a total pancreatectomy with duodenal preservation. The operative procedure is extremely tedious; pain relief is achieved in 75–80% of patients and no postoperative deaths have been reported. Early complications include bleeding, sepsis and duodenal fistula. However, at a later stage patients may develop bile duct or duodenal stricture. This procedure is also offered as a last resort as is total pancreatectomy.^{73,74}

Extended drainage procedures

Rumpf's extended drainage procedure

This is a combination of Partington's procedure with a transduodenal pancreatic sphincteroplasty. It is indicated when there is a pre-papillary obstruction to the drainage of pancreatic duct due to stones or stricture.⁷⁵

Resection with extended drainage

The reported incidence of inflammatory mass in the head is about 30% of which only 10% are malignant.⁷⁶ Resection with extended drainage procedure provides cure in up to 95% of cases.⁷⁷

Extended Begar's procedure

In cases where there are multiple strictures in the left pancreas with an inflammatory mass in the head, this procedure has a superior result (Figs. 3 and 4). In addition to the duodenum preserving head resection a side to side pancreaticojejunostomy is performed after slitting open the main pancreatic duct.

Frey's procedure

A modified procedure combining lateral pancreaticojejunostomy of Partington–Rochelle with coring out of the pancreatic head (overlying the ducts of Wirsung and Santorini and the uncinate process)

using a diathermy, keeping at least 5 mm pancreatic tissue posterior and medially (Fig. 5). If the duct is less than 8 mm in size mucosa to capsule anastomosis is performed. This procedure is indicated for pain in chronic pancreatitis with its complications like pseudocyst, common bile duct obstruction, pancreatic ascites, fistulae and recurrent pain after lateral pancreaticojejunostomy. It is contraindicated in patients where cancer cannot be excluded.^{78,79}

Izbicki's "V" shaped ventral pancreatic excision

In this procedure a long "V" shaped excision of ventral aspect of the pancreas is done with a lateral pancreaticojejunostomy by a mucosa to capsule anastomosis. This procedure drains the main as well as the second and third order ducts. This is an ideal procedure for small duct disease with a maximum diameter of the Wirsung's duct less than 3 mm.⁸⁰

Pancreatic denervation alone

Splanchnic nerves and the sympathetic trunks indicate pain arising from the pancreas, extrahepatic biliary ducts and gastrointestinal tract from the level of the stomach to the rectosigmoid. Interest in surgical neurectomy has progressed by the observation that fibers which mediate pancreatic pain interconnect only through the celiac and superior mesenteric plexus. Various methods of denervation have been described.

Left splanchnicectomy with celiac ganglionectomy with or without vagotomy

Mallet Guy advocated an extra peritoneal approach through the 12 ribs for left splanchnicectomy with celiac ganglionectomy.⁸¹ This is done after correcting the extra pancreatic pathology.

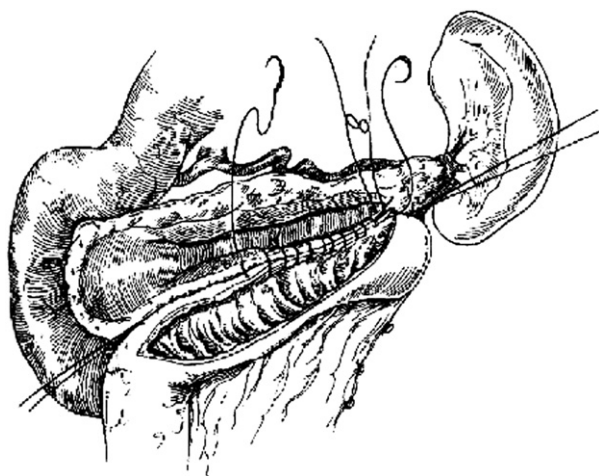


Figure 3 The Partington Rochelle procedure.

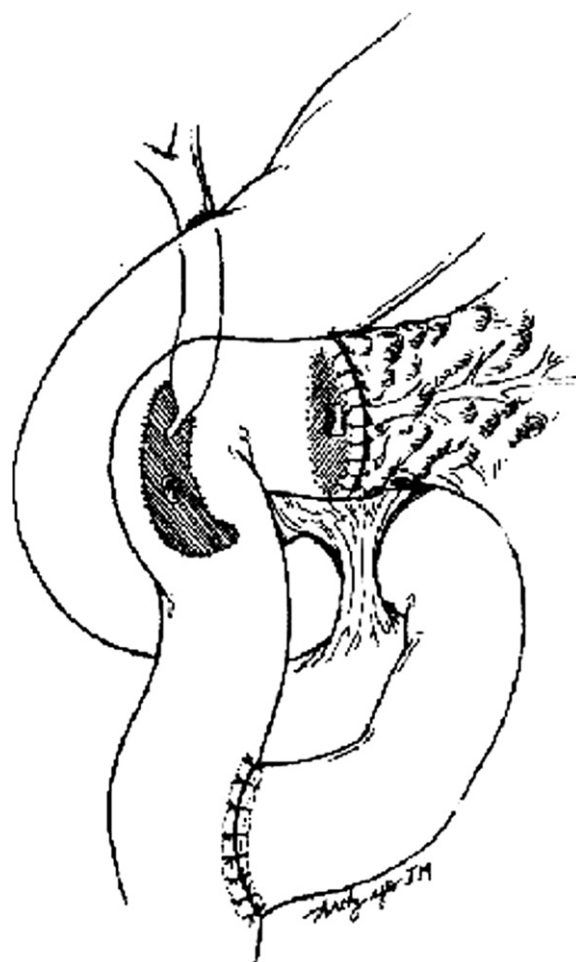


Figure 4 The Begar's procedure.

In a 5-year follow up of these patients there was an 84% overall improvement. However, the failure rate was up to 31% in patients with diffuse pancreatic fibrosis and no discernable extra pancreatic

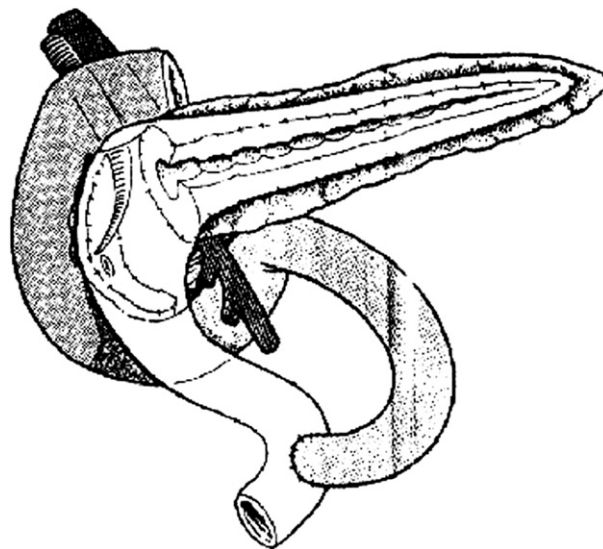


Figure 5 The Extended Begar's procedure.

cause.⁸² The role of vagal fibers in pancreatic pain is unclear. Generally however, bilateral vagotomy is considered to increase the completeness of pancreatic denervation.

Complete pancreatic denervation

Hirokawa described a more extensive denervation procedure, which includes freeing the pancreas from the posterior abdominal wall and resection of all postganglionic pancreatic nerve plexus including those surrounding the common hepatic and splenic arteries.⁸³ Follow up is short, probably this procedure may provide a reasonable alternative to extensive resection.

Transthoracic/videothoracoscopic pancreatic denervation

There are important thoracic anatomical considerations regarding the innervation to the pancreas. The greater splanchnic nerves are largely responsible for pain in supramesenteric viscera and the nerve trunks lie above the level of the 10th thoracic vertebra and descend along the spine to end in the celiac plexus, similarly the lesser splanchnic plexus. Transthoracic denervation can be achieved by division of the splanchnic nerves with bilateral vagotomy performed through a left thoracotomy. A similar procedure is now performed using a videothoracoscopic technique.⁸⁴ This minimally invasive procedure achieved results almost equal to those of major abdominal surgery. Follow up of 12 months demonstrated an improved quality of life. This procedure may be considered for patients who do not meet anatomic criteria for drainage and those who may not be candidates for major abdominal surgery.

Pancreatic auto-transplantation

Although subtotal and total pancreatectomies successfully alleviate the pain of chronic pancreatitis, patients develop troublesome insulin dependent diabetes mellitus. This can be overcome auto-transplantation.

Islet cell auto-transplantation

The Mirkowitch technique which is used to prepare partially purified islets produces a fairly large volume of minced digested islet cell tissue which is then injected into a portal vein. Despite slow injection portal pressure is markedly raised several fold. Hinshaw et al. developed and tested a more sophisticated islet preparation technique. This technique produced a 5 ml tissue pellet containing 500,000–2000,000 islets for transplantation,⁸⁵ no problems were noted with this preparation and the portal

pressure remained essentially unchanged. Long-term success (insulin independence) with both these techniques is reported at 40–43%.^{85,86}

Segmental pancreatic transplantation

This technique comprises auto-transplantation of the resected body and tail of the pancreas into the thigh following near total pancreatectomy. The splenic vessels are anastomosed to the femoral vessels. The divided end of the pancreas is closed and the duct is ligated⁸⁷ or injected with synthetic polymers (e.g., prolamine or neoprene). Duct obliteration is thought to cause rapid and permanent atrophy of the exocrine pancreas and preserves endocrine function.⁸⁸ However, others concluded that duct obliteration does not prevent relapse or progression of chronic pancreatitis in the preserved pancreatic segment.⁸⁹ Internal drainage of the duct into a Roux-en-Y limb of jejunum has also been reported with good results.⁹⁰ Technical success was achieved in up to 80% of patients with pain relief in 80% and insulin independence in 70%.⁸⁷

Ruling out a malignant neoplasm

There is evidence to suggest that chronic pancreatitis could predispose to pancreatic malignancy.⁹¹ Studies show that the risk rises with duration from 1.8% at 10 years to 4% at 20 years and it has been speculated that it is due to the increased levels of growth factors⁹²; another report showed a 6% malignant change of inflammatory head mass at 9 years follow up.⁵⁶ Concomitant malignancy has been reported in 15–21% of patients undergoing surgery for chronic pancreatitis which may be detected at surgery or on follow up.⁹³ Differentiating a malignant neoplasm in the head of the pancreas from an inflammatory mass of chronic pancreatitis is a major challenge for the surgeon which needs to be addressed at the time of surgery. The head in chronic pancreatitis is hard and enlarged so the hope of detecting carcinoma by palpation is not possible and is only an illusion. A 15% error in sampling as well as interpretation makes frozen section an unreliable tool to exclude malignancy.⁹⁴ Therefore a high degree of suspicion is to be entertained in these patients. In such situation only resection probably pancreaticoduodenectomy should be preferred as any lesser procedure may leave behind the lesion or cause tumor spillage.

Control of complications

Associated complications of adjacent organs resulting from chronic pancreatitis like CBD and duodenal obstruction with gastric outlet obstruction require

bypass procedures or resection of the inflammatory mass. Frequently, these bypass procedures become necessary after lateral pancreaticojejunostomy. With pylorus preserving resections these additional procedures are not required. This safely and effectively combines the control of complications with the preservation of original anatomy and thus is a more physiological procedure.

The relevance of segmental portal hypertension in a patient of chronic pancreatitis is poorly understood. Complications of segmental portal hypertension are rare and its presence should not influence the choice of operation.

Complications such as internal fistula, pseudocysts, pancreatico-portal fistula, or pseudoaneurysm require an individualized approach.

Conclusion

The old controversy "resection or drainage" is probably now irrelevant. Both have established roles and probably best results are achieved by a combination of both. Chronic pancreatitis is such a complex and variegated disease that there is never a single procedure that would achieve goals in all patients. Therefore, it is important to understand that the choice of surgery has to be individualized to address the pathological change in each patient. However, ultimately it is the surgeons experience and an operative strategy that is slightly modified for every patient that is going to achieve the best possible results and that is what would be ultimately an ideal or somewhat close to ideal procedure for chronic pancreatitis. However, most of the operative procedures described in this monogram need a larger series of treated patients to be followed to adopt a definitive and probably better future strategy for managing this complex problem.

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